



50 Years of Arid Zone Research in India

A.V. Rao
D.C. Ojha
Anurag Saxena



Central Arid Zone Research Institute, Jodhpur
Scientific Publishers (India), Jodhpur



**50 Years
of
Arid Zone Research in India
(1947-1997)**

— An Annotated Bibliography —

**A.V. Rao
D.C. Ojha
Anurag Saxena**



Central Arid Zone Research Institute, Jodhpur
Scientific Publishers (India), Jodhpur

Central Arid Zone Research Institute
Jodhpur - 342 003 (India)

Published by :
PAWAN KUMAR
Scientific Publishers (India)
5-A, New Pali Road, P.B. No. 91
JODHPUR - 342 001 (India)
FAX : 0291-613480 & 649093

ISBN : 81-7233-188-6

© Editors, 1998

First Edition : 15th August, 1998

Assisted by : Sunita Arya
Tirth Das
Rajesh Kumar Dave

Laser typeset : Rajesh Ojha

Printed in India

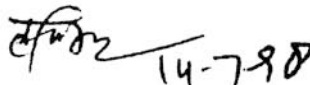
FOREWORD

Arid zones in its broadest sense may be defined as the areas experiencing chronic water deficits. In 1952, first time the National Institute of Science, India, took the initiative and organised a symposium on 'Rajputana Desert'. The proceedings of the symposium revealed that the desert was expanding at the rate of one mile a year into the fertile Indo-Gangetic plains. The UNESCO took it very seriously and in 1958 requested Mr. C.S. Christian, CSIRO, Australia to visit India and advise the Government of India for establishing Central Arid Zone Research Institute at Jodhpur. Since then the institute is working for the over all development of country's arid areas.

The institute has since completed 40 years and for the period, the scientists at the CAZRI, Jodhpur are engaged in assessing and monitoring of desertification in the arid eco-system as well as in finding suitable technologies to control this process of desertification. Besides CAZRI, a number of State and Central Government organizations are also involved in conducting research for the overall sustainable development of arid areas. A large number of research publications brought out by the scientists involved in arid zone development, were scattered in the various national and international periodicals. A need to collect and bring this large wealth of information in the form of a publication has long been felt.

I am very happy that Drs. A.V. Rao, D.C. Ojha and Anurag Saxena took it as a challenge and have brought out this publication covering a period of 50 years (1947-1997) on the eve of Golden jubilee Celebrations of India's Independence. I am confident that this publication will prove to be an asset in searching the desired information on arid zone research in India to scientists, researchers, teachers, progressive farmers and all those who are concerned with the sustainable development of arid zones.

I compliment Drs. Rao, Ojha and Saxena for their initiative and efforts for this excellent publication.



(A.S. FARODA)

Director

Central Arid Zone Research Institute

Jodhpur - 342 003

PREFACE

The man's struggle against aridity started in antiquity. Until recently most of the success in obtaining higher productivity in arid regions came through the trial and error method and through learning from successful experiences. But at a later stage, specially after freedom, it became increasingly important to apply scientific and technical knowledge for making the optimum use of the available resources for the over all development of the desertic people.

The arid zone of India covers about 12% of the country's geographical area, and occupies over 32 lakh sq. km. of hot desert located in parts of Rajasthan (61%), Gujarat (20%), Andhra Pradesh (7%), Punjab (5%), and Haryana (4%). In addition to this an area of about 70,000 sq. km. of cold desert in Ladakh in Jammu and Kashmir presents an entirely different set of agroclimatic conditions compared to the hot deserts (Fig. 1). The arid regions are characterized by low and erratic rainfall, extreme temperatures, high wind velocity, low humidity and frequent droughts. The productivity is low primarily due to lack of adequate growing period. In Ladakh, extreme aridity combined with low temperature limits the possibility of growing crops to about 5 months in a year. The agriculture in Ladakh depends largely on quick growing cereals, oilseeds and fodder crops and rearing of sheep for pashmina wool. In contrast to cold arid, hot arid regions have an abundance of sunshine, land and soils capable of responding to management, well adopted grasses and trees, annual crops, excellent breeds of goat, sheep and cattle and considerable reserve of groundwater. The areas used exclusively for grazing in western Rajasthan has dropped while the population of grazing animals has increased. Most of the land in the arid zone fit for only forestry or range mangement, is increasingly being brought under cropping.

In western Rajasthan, different types of fluvial and aeolian fragile ecosystems occur and they are undergoing morphological and biological changes due to natural and accelerated desertification processes like soil erosion by wind and water, salinity/alkalinity and water logging. In last few decades, the impact of human and livestock population on arid ecosystems has increased manifold which has disturbed the ecological balance of these ecosystems resulting in the desertification/depletion of their biological productivity.

The problems of the area and the need for finding a scientific solution has been a matter of serious concern for scientists and technologists. National Institute of Science now known as Indian National Science Academy

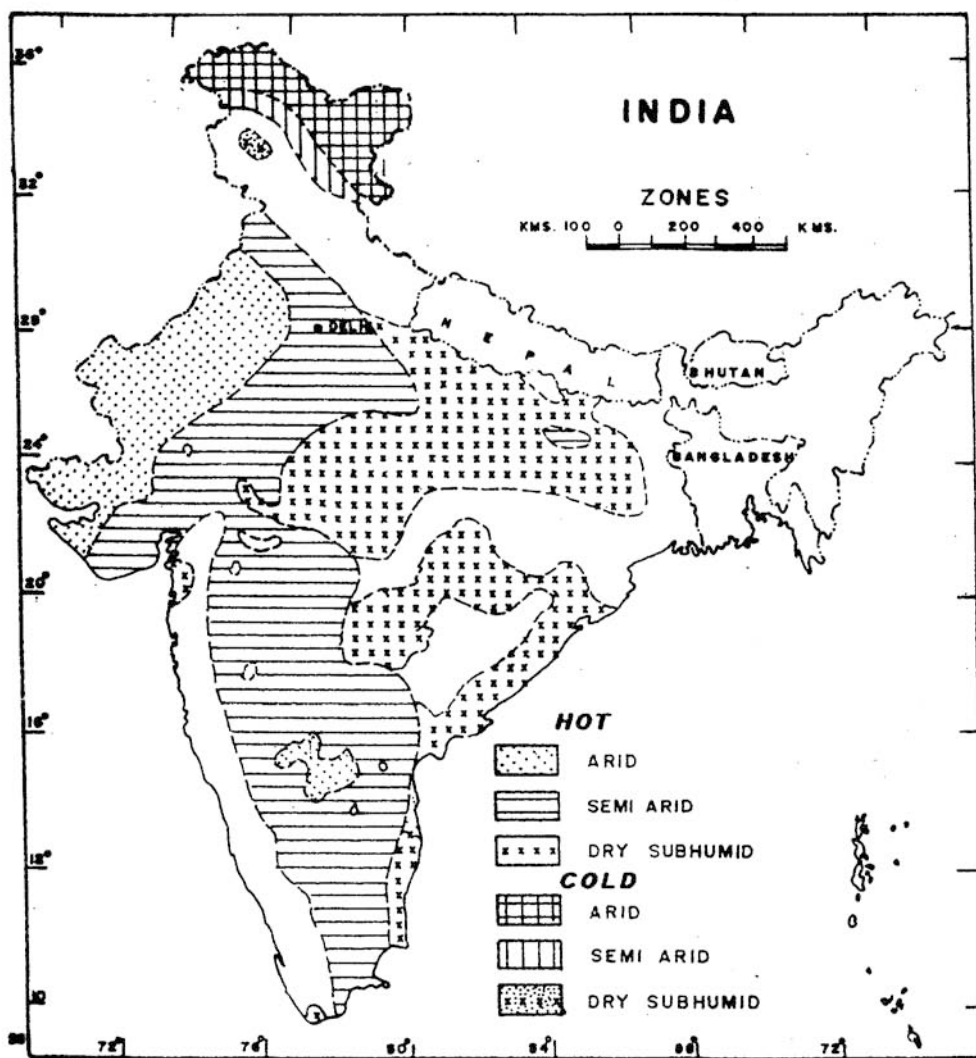


Fig. 1. Arid, Semi-arid and Dry Sub-humid Zones

organised a symposium on 'Rajaputana Desert'. As a sequel to the recommendations of this symposium, Government of India, established a Desert Afforestation station at Jodhpur in the same year. In 1957, the scope of the station was enlarged by inclusion of soil conservation programme and it was renamed as the Desert Afforestation and Soil Conservation station for development of crop husbandry and grasslands. Later, on the recommendations of Mr. C.S. Christian (UNESCO adviser) this Institute was reorganised in 1959 as the Central Arid Zone Research Institute (CAZRI). The institute's foundation was laid with the aim to tackle the arid zone problems in India in general and Rajasthan in particular.

During the period of 50 years (1947 to 1997) not only the CAZRI but also the other research and academic institutions located in Rajasthan and other arid states of India contributed a lot in the form of research articles in various National and International journals.

This publication which contains the contribution of more than 1143 authors has been divided in 16 groups. The publications running in around 650 pages has got 2357 references. The publications supplied by the scientists from various organizations, scientific journals available in Dr. Raheja Library and various bibliographies have been the principal source for this publication. The study of the publications interestingly reveals that the research publications on Arid Zone in India were at its peak during 1976-77 and subsequently showed a downward trend (Fig. 2).

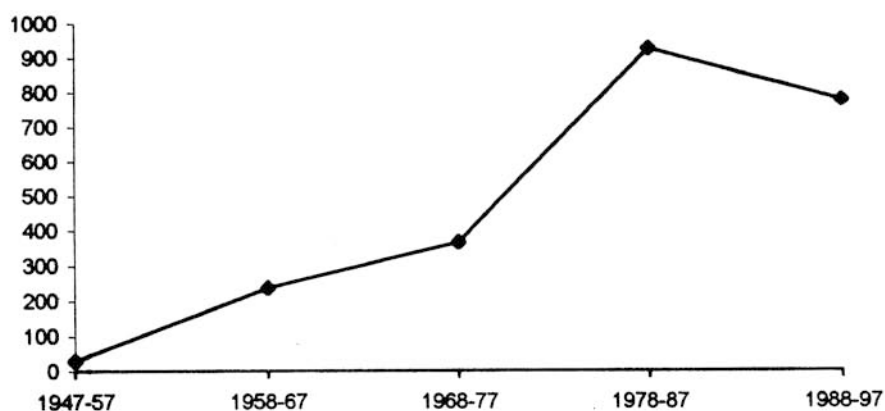


Fig. 2. Trend in Publication of Research Papers over Different Periods

In the end of the bibliography two chapters on Books and Monographs have been added. These chapters contain the information about the most relevant books and monographs published on Arid Zone in India. Author index, Source index and list of commonly growing plants in arid zone, provided at the end will be helpful to the readers in tracing the desired information. All the journals have been rendered in their full form. All the entries have been arranged alphabetically within the particular subject but serially numbered.

We express our deep sense of gratitude to Dr. A.S. Faroda, Director, CAZRI, Jodhpur, who had always been the source of inspiration and the encouragement during the course of this publication. The editors sincerely thank all the authors especially CAZRI scientists for providing reprints and other material and their cooperation for correcting the print-outs in time and to the other institutes working on arid zone problems for providing relevant information. We also wish to record our thanks to all the staff members of Dr. Raheja Library, CAZRI, especially to Ms. Sunita, Mr. Tirth Das and Mr. Rajesh Kumar Dave, who had extended their unstinted cooperation and help for bringing out this publication.

We shall consider our labour amply rewarded if this compilation comes as an aid to scientists and researchers in their search for published information in their respective fields for project formulations and policy planning. The bibliography is really of those, either who have contributed for 'arid zone research' or to those who will make use of it.

A.V. Rao
D.C. Ojha
Anurag Saxena

CONTENTS

<i>Foreword</i>	<i>v</i>
<i>Preface</i>	<i>vii</i>
1. NATURAL RESOURCES AND DESERTIFICATION	1
Climate and Drought	1
Land Resources	19
Soil Resources	39
Water Resources	73
Plant Resources	97
Land Use	112
Land Degradation	124
2. CROP IMPROVEMENT	133
Cereals and Millets	133
Legumes	141
Oilseeds	151
Others	159
3. CROP PRODUCTION	160
Agronomic Practices	160
Stress Physiology	198
Integrated Nutrient Management	222
Rain Water Management	251
Irrigation Water Management	257
Weeds	272
Diseases	275
Insects and Nematodes	287
Rodents and Birds	308
4. FRUITS AND VEGETABLES	331
Ber	331
Pomegranate	340
Date Palm	343
Vegetables	345
Others	348

5.	FORAGE PRODUCTION	353
	Grasses and Pasture legumes	353
	Rangeland Management	383
6.	FOREST AND ECONOMIC PLANTS	399
	Silviculture	399
	Plants of Economic Importance	437
7.	ALTERNATE LANDUSE SYSTEMS	453
	Silvi-Pasture	453
	Agro-forestry	455
	Ley Farming	458
8.	WATERSHED MANAGEMENT & SOIL CONSERVATION	460
	Watershed Management	460
	Soil Conservation	465
9.	LIVESTOCK PRODUCTION AND MANAGEMENT	471
	Goat	471
	Sheep	474
	Cattle	494
	Camel	498
	Animal Nutrition	499
10.	WASTELAND MANAGEMENT	505
	Saline and Alkali Soils	505
	Rocky plains and Mine spoils	512
11.	ENERGY MANAGEMENT	517
	Solar and Wind Power	517
12.	SOCIO-ECONOMICS AND AGRICULTURAL EXTENSION	533
	Sociology	533
	Agriculture Economics	548
	Agricultural Extension	571
13.	WILDLIFE	578
14.	MISCELLANEOUS	582
15.	BOOKS	585
16.	MONOGRAPHS	598
	AUTHOR INDEX	611
	SOURCE INDEX	628
	APPENDIX	634
	Important Vegetation of Arid Zone	634